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# Biodiversity and Abundance of Benthic Macro Invertebrates Community 0f Datte-Da-Talab Pond, Birpur (J&K) India

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**Abstract**

A Perennial pond "Datte Da Talab" has a dense population of benthic communities and it plays an important role in the exchange of nutrient cycles in the aquatic ecosystem. Fourteen (14) different species were identified in the present investigation belonging to three groups viz. Annelida (3 taxa), Arthropoda (8 taxa) and Mollusca (3 taxa). Arthropoda represented by Chironomus chironomus, Chironomus pupae, Pentaneura sp., Culicodes sp., Tabanus sp., Berosus sp., Paracymus sp., Hydroglyphus sp. and Canthydrus sp. The population of Mollusca was represented by Melanoides tuberculata, Physa sp. and Gyralus sp. Annelida dominated by Tubifex tubifex, Branchiura sp. and Dero digitata. Arthropoda was the dominant group among all and it constitutes 43.19 % of the total macrobenthic invertebrates collected. Mollusca were the second dominant group and contribute 38.55 % of total macrobenthic population. Whereas group Annelida was the least abundant among all and it shared 18.26 % of total macrobenthic fauna of pond. The maximum abundance of macrobenthic organisms recorded from station IV and minimum at the station I, which was 11558 and 7712 individuals/$m^2$sediment respectively. The relative species diversity, species richness, dominance and evenness were calculated. The value of Simpson index ranged between H' = 0.48 to 0.69. The value of Shannon-Weiner index was higher (I = 1.66) at station III. Species richness in term of Maraglef's index and Menhinick's index varied between minimum valued $R_1$= 1.08 (Station IV) to a maximum value $R_1$ = 1.22 (Station III) and a minimum valued $R_2$= 0.105 (Station IV) to a maximum value $R_2$ = 0.133 (Station III) respectively. The minimum evenness value was observed at station I and maximum at station III the values being E = 0.581 and E = 0.668 respectively. The pond was investigated monthly during the year 2011-2012 for various physico-chemical parameters and macrobenthic invertebrates. Among physico-chemical parameters Depth, Transparency, pH, Water Temperature, Air Temperature, Weather conditions, Dissolved oxygen, Free carbon dioxide, Carbonates, Bicarbonates, Calcium, Magnesium, Chlorides, Phosphates, Sulphates and Nitrates were monitored which showed well marked seasonal fluctuations.

**Keywords:** Macrobenthic invertebrates, diversity, richness, abundance, evenness and seasonal fluctuations.

## INTRODUCTION

Macrobenthic communities are the organisms that live on, or in, the bottom of the water body. The benthic animals are extremely diverse and are represented by all phyla from protozoans, through large macro invertebrates to vertebrates [1]. The diversity and abundance of benthic fauna are most frequently used in biomonitoring studies because they significantly respond to various organic and inorganic pollution [2, 3]. Extended residency period of various macrobenthic communities in specific habitats and presence or absence of particular benthic species in a particular environment can be used to group them as bio-indicators of specific environmental & habitat conditions [4]. These benthic organisms contribute a lot to the food chain, as after their death and decay they are used by aquatic plants and other animals. The diversity and abundance of benthic inhabitants of a particular water body is much influenced by physico-chemical status of water body which do show seasonal alterations depends on cascade of events [5]. Similar work on macrobenthic invertebrate fauna was investigated by various workers in different water bodies [6-10]. The main aim of this study was to determine the biological richness of the pond with particular emphasis on the structure of macro invertebrate community & the physico-chemical environment of the pond to assess the water quality which is used as the source of bathing and drinking by local people. This preliminary investigation enabled a comprehensive and systemic analysis of the monthly physico-chemical fluctuations and macrobenthic invertebrate diversity of subtropical perennial pond "Datta da Talab" of Jammu and this baseline data generated would help in planning better conservation measures and management of the religiously and biologically important subtropical perennial pond.

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## MATERIAL AND METHODS

### Location and Site Description

Pond Datte da Talab is a sub-tropical temple pond of Samba district of Jammu division and is located at 32°39'50" N and 74°57'10" E at an average elevation of 423 meters above msl. This holy temple pond is very famous for its religious and therapeutic importance. Four sites were selected for the present study at four

different sides of the concrete rectangular pond. (Fig. 1)

**Fig. 1:** Showing view of study area (Datte-da-Talab pond)

### Collection of samples

### Physico-chemical analysis of water

For studying physico-chemical parameters of water, monthly sampling was done from May, 2011 to April, 2012. Water samples were collected in plastic water samplers of two litre capacity. Measurement of parameters like air temperature, water temperature, depth, transparency, pH, $FCO_2$, $HCO_3^-$, DO and $CO_3^{2-}$ was done on the spot and rest were determined within two hours of water sample collection in the laboratory following standard methodology of Adoni [11] and A.P.H.A [12].

### Macrobenthic invertebrate sampling

The samples were collected with the use of an Ekman dredge and the collected samples were washed through sieve no 40 (256 meshes/cm$^2$) and macrobenthic invertebrates were transferred to vials containing 5% formalin for further identification. The organisms were segregated and their abundance was calculated as no. per square meter according to Jhingran *et al.* (1969) [13] and Welch (1952) [14]. Preserved samples of macro benthic invertebrates were identified according to Ward and Whipple (1959) [15], Tonapi (1980) [16], Adoni (1985) [11] and Pennak (1978) [17]. However, for quantitative analysis, species-wise individual counting was done in the whole sample or sub sample. The number of benthos per unit area was calculated as follows:

$$\text{Benthos No. /m}^2 = \frac{N}{A \times S} \times 1000$$

Where,
N = Number of organism collected per sample
A = Biting area of sampler (15 X 15 cm)
S = Number of samples taken

### Statistical analysis

To understand a particular biotic community, it is important to work out various indices. In this case, species diversity and species richness was calculated using Shannon-Weaver Index (H) (Shannon and Weaver, 1949) [18], Simpson's Index (I) (Simpson, 1949) [19], Maraglef's Index ($R_1$) (Margalef, 1958) [20] and Menhinick's Index respectively. Evenness was calculated by Pielou's index (E) (Pielou, 1975) [21].

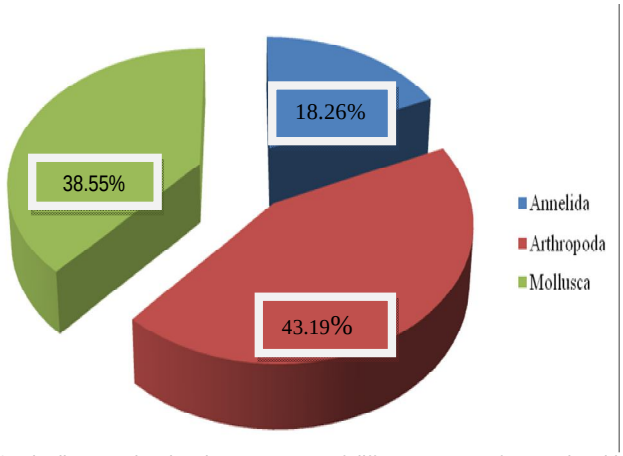


**Fig. 2:** Pie diagram showing the percentage of different groups of macro-benthic invertebrate in the study area.

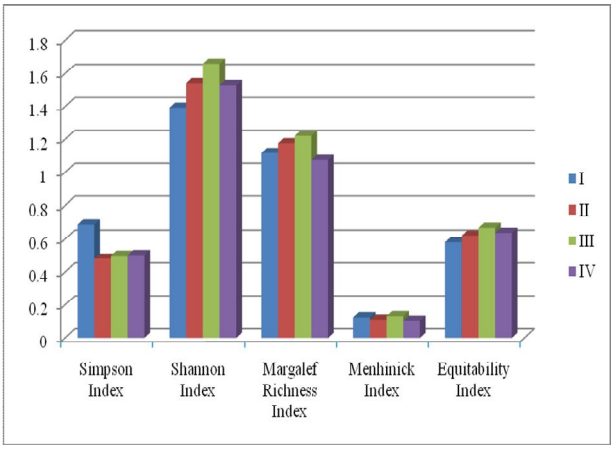


**Fig. 3:** Graphic representation of macrobenthic fauna diversity, evenness and richness during the study period.

## RESULT AND DISCUSSIONS

### Analysis of water quality parameters

Mean Variations in the physico-chemical parameters of pond Datte-da-Talab is shown in table 5. The water of this pond has alkaline status as the pH recoded variation between 7.65±0.21 to 9.40±0.24. From the detailed review, major parameters showed limits within the permissible limits of WHO (1993) [22] and ISI (1991) [23] but the value of phosphates and nitrates indicate the ascend towards eutrophication due to organic pollution.

### Qualitative analysis

Qualitatively macrobenthic invertebrates analysis showed the presence of three species of phylum Annelida belonging to the class Oligochaeta (*Tubifex tubifex, Branchiura* sp., *Dero digitata)*, six species of phylum Arthropoda belonging to two orders, Diptera

(*Chironomus chironomus,* Chironomous pupae*, Pentaneura* sp., *Culicodes* sp., *Tabanus* sp.) and Coleoptera (*Berosus* sp., *Paracymus* sp., *Hydroglyphus* sp. *and Canthydrus* sp.) and three species of phylum Mollusca belonging to three families Thiaridae (*Melanoides tuberculata*), Physidae (*Physa* sp.) and Planorbidae (*Gyralus* sp.).

**Quantitative analysis**

Individuals representing 14 taxa were collected from the study area as shown in the table 1. Of these, phylum Arthropoda contributed the largest share constituting 43.19% of the total macro-benthic invertebrate fauna, followed by the phylum Mollusca (38.55%) and phylum Annelida (18.26%) (Table 3 & Figure 2). Among phylum Arthropods, *Chironomus chironomus* was the dominant species and it contributed 87.14 % to the total Arthropods population. *Culicodes* sp. was the second dominant species (5.71%), followed by *Pentaneura* sp. (4.82%) and other coleopteran contributes only 2.33%.

Among Molluscs, *Gyralus* sp. was the dominant species and it contributed 56.57% of total Molluscan fauna collected from the study area, followed by *Melanoides tuberculata* (42.89%) and minor representation was of the *Physa* sp. (0.24%). Group Annelida was the third dominant group. Among Annelids, *Tubifex tubifex* was the dominant species represents 90.52% of the total species of Annelids collected from the study area followed by *Branchiura* sp. and *Dero digitata* shared 7.04% and 2.44%.

Four stations of the pond recorded different number of macrobenthic fauna. Maximum abundance of macrobenthos was 11558 no. /$m^2$ recorded in station II followed by 10958 no. /$m^2$ in station IV whereas station I and III recorded comparatively less abundance of 7712 and 8189 no. /$m^2$ respectively. Station II and IV were found to be denser than station I and III which may be due to presence of aquatic vegetation and lesser aquatic disturbance in these stations.( Table 2)

For statistical analysis, the macrobenthic invertebrate fauna was analyzed for species diversity, species richness, dominance and evenness which showed great variations (Table 4 & Figure 3). The value of Simpson index ranged between H'=0.48 to H'= 0.69 and the recorded value were in the following order at different stations:
Station I > Station IV > Station III > Station II

The value of Shannon-Weiner index was higher (I = 1.66) at station III. Species richness in term of Maraglef's index and Menhinick's index varied between minimum valued $R_1$= 1.08 (Station IV) to a maximum value $R_1$ = 1.22 (Station III) and a minimum valued $R_2$ = 0.105 (Station IV) to a maximum value $R_2$ = 0.133 (Station III) respectively. The hierarchical order of these indices is as follows:
Station III > Station I > Station II > Station IV

The minimum evenness value was ranged between E = 0.581to E = 0.668 and the observed order at different stations are
Station III > Station IV > Station II > Station I
Such biodiversity and abundance in the benthic macro invertebrate community have already been put in record in various aquatic ecosystems [6, 24-29]

**Table 1:** Distribution of different macro benthos in Datte-da-Talab pond.

| Phylum | Class | Order | Family | Organisms | Station | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | I | II | III | IV |
| **Annelida** | Oligochaeta | | Tubificidae | *Tubifex tubifex* | + | + | + | + |
| | | | | *Branchiura* sp. | + | + | + | + |
| | | | Naididae | *Dero digitata* | + | + | + | + |
| **Arthropoda** | Insecta | Diptera | Chironomidae | *Chironomus chironomus* | + | + | + | + |
| | | | | Chironomus pupae | + | + | + | + |
| | | | | *Pentaneura* sp. | + | + | + | + |
| | | | Ceratopogonidae | *Culicodes* sp. | + | + | + | + |
| | | | Tabanidae | *Tabanus* sp. | - | + | - | - |
| | | Coleoptera | Hydrophilidae | *Berosus* sp. | + | + | + | + |
| | | | | *Paracymus* sp. | - | + | + | - |
| | | | Dytiscidae | *Hydroglyphus* sp. | + | + | + | + |
| | | | Noteridae | *Canthydrus* sp. | - | - | + | + |
| **Mollusca** | Gastropoda | Mesogastropoda | Thiaridae | *Melanoides tuberculata* | + | + | + | + |
| | | | Physidae | *Physa* sp. | + | - | - | - |
| | | Bsommatophora | Planorbidae | *Gyralus* sp. | + | + | + | + |
| **Total** | | | | 14 | 11 | 12 | 12 | 11 |

**Table 2:** Distribution of macrobenthic organisms (No. /$m^2$) at different stations during the period of six months

| | | Station | | | |
|---|---|---|---|---|---|
| | | I | II | III | IV |
| **Oligochaeta** | | *2108* | *2556* | *594* | *1755* |
| **Insecta** | *Diptera* | *4389* | *4102* | *4004* | *3717* |
| | *Coleoptera* | *63* | *54* | *162* | *99* |
| **Gastropoda** | *Mesogastropoda* | *522* | *2391* | *1368* | *2106* |
| | *Bsommatophora* | *630* | *2455* | *2061* | *3276* |
| **Total Organisms** | | *7712* | *11558* | *8189* | *10953* |

**Table 3:** Percentage distribution of different phylum in the pond

| S.No. | Organisms | Total Number | Percentage |
|---|---|---|---|
| 1. | Annelida | 7013 | 18.26% |
| 2. | Arthropoda | 16590 | 43.19% |
| 3. | Mollusca | 14809 | 38.55% |
| Total | | 38412 | 100% |

**Table 4:** Values of various diversity indices showing species diversity, richness and evenness at different stations of the pond.

| S. No. | Stations | I | II | III | IV |
|---|---|---|---|---|---|
| 1. | Total number of species | 11 | 12 | 12 | 11 |
| 2. | Total number of organisms | 7712 | 11558 | 8189 | 10953 |
| 3. | Average population size | 701.1 | 963.2 | 682.4 | 995.7 |
| 4. | Simpson Index | 0.69 | 0.48 | 0.499 | 0.50 |
| 5. | Shannon Index | 1.39 | 1.54 | 1.66 | 1.53 |
| 6. | Margalef Richness Index | 1.12 | 1.18 | 1.22 | 1.08 |
| 7. | Menhinick Index | 0.125 | 0.112 | 0.133 | 0.105 |
| 8. | Equitability Index | 0.581 | 0.621 | 0.668 | 0.638 |

**Table 5:** Physico-chemical parameters of pond Datte-da-Talab, Jammu showing maxima and minima.

| S.No. | Physico-chemical parameters | Average ± SD | |
|---|---|---|---|
| | | Maxima | Minima |
| 1 | Air temperature | 38.50 ± 0.50 (May) | 14.30 ± 0.54 (December) |
| 2 | Water temperature | 33.00 ± 1.22 (May) | 11.63 ± 0.65 (December) |
| 3 | pH | 9.40 ± 0.24 (February) | 7.65 ± 0.21 (November) |
| 4 | Free carbon dioxide | 5.95 ± 1.49 (November) | 0.0 ± 0.0 (May-Octob December, February a March) |
| 5 | Dissolved oxygen | 11.3 ± 0.17 (February) | 1.18 ± 0.23 (July) |
| 6 | Carbonates | 76.50 ± 4.97 (July) | 0.0 ± 0.0 (November) |
| 7 | Bicarbonates | 426.98 ± 17.79 (December) | 190.63 ± 13.21(March) |
| 8 | Chlorides | 52.70 ± 4.17 (May) | 11.98 ± 1.41 (October) |
| 9 | Calcium | 40.90 ± 4.05 (November) | 16.43 ± 3.82 (February) |
| 10 | Magnesium | 42.28 ± 6.39 (October) | 16.53 ± 1.98 (February) |
| 11 | Phosphates | 0.05640 ± 0.0282 (May) | 0.0 ± 0.0 (September, November, January and February) |
| 12 | Sulphates | 0.001831 ± 0.000090 (April) | 0.0 ± 0.0 (September and October) |
| 13 | Nitrates | 0.5728385 ± 0.0000444 (July) | 0.572503 ± 0.0000179 (December) |

**CONCLUSION**

Benthic fauna are the food for bottom feeding fishes [30] and also indicates the status of water body. In the present study presence of some macrobenthic invertebrates such as Chironomus chironomous, Tubifex tubifex etc. along with alarming range of few physico-chemical parameters infers that the water is getting polluted and this pond is in the initial stages of eutrophication so, there is a pressing need to gain ecological knowledge about this pond from properly recorded water quality data and improve the management in such a way that it may be utilized not only by present generation but is made available to future generations

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